

Sayer (R.H.)
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of the Author.

THE
IMMEDIATE
RESTORATION OF PARTS
TO THE NORMAL POSITION
AFTER TENOTOMY.

BY
REGINALD H. SAYRE, M. D.,
ATTENDING ORTHOPEDIC SURGEON TO THE OUT-DOOR DEPARTMENT OF BELLEVUE
HOSPITAL, NEW YORK.

READ BEFORE THE ORTHOPEDIC SECTION OF THE ACADEMY OF
MEDICINE, MAY 21, 1886.

REPRINTED FROM THE ALABAMA MEDICAL AND SURGICAL JOURNAL.

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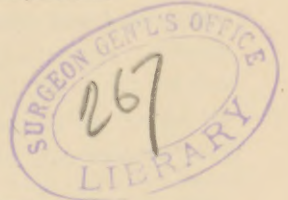
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THE IMMEDIATE RESTORATION OF PARTS TO THE NORMAL POSITION AFTER TENOTOMY.*

BY REGINALD H. SAYRE, M. D.,

Attending Orthopedic Surgeon to the Out-Door Department of Bellevue Hospital, New York.

Mr. President and Gentlemen :

ALTHOUGH there is nothing new in the principles which I shall advocate this evening, I feel justified in occupying your time in the discussion of the subject, from the fact that my views, of whose correctness I am convinced, are in opposition to those held by the majority of surgeons, both at home and abroad, and in the last volume of the International Encyclopedia of Surgery which I received only last week from the press, and which is supposed to embody the most recent ideas on the Science of Surgery, I find advocated the opposite principles to those which I hold.

In speaking of Talipes Equinus involving contracted plantar fascia, the author says:†

“After tenotomy of plantar fascia, a flexible splint, well padded, is then placed on the leg and foot to keep the latter at rest. After three days all the dressings are removed, and the superficial wounds, which are merely small punctures the size of the blade of the knife, will be found to be completely healed; mechanical treatment is then at once commenced. * * * For the first twenty-four hours the limb is merely kept resting in its original state of deformity, the instrument is then taken off, and the leg and foot are examined to see if too much pressure has been exercised at any one spot from over-tightening of the straps; a fresh bandage is applied, and the instrument replaced, the front of the foot being raised upward as much as can comfortably be borne by the patient. * * *

The reduction of the deformity of

* Read before the Orthopedic Section of the Academy of Medicine, May 21, 1886.

† The International Encyclopedia of Surgery, edited by John Ashurst, Jr., M. D., New York, 1886, article, “Club Foot,” by Frederic R. Fisher, F. R. C. S. Volume VI., p. 1012.

the foot in a case such as is now being considered will take from two to three months to complete, and when the contraction of the plantar surface has been overcome the restoration of free movement at the ankle joint must be proceeded with."

He then gives directions for dividing the tendo Achillis, and continues, "at the end of four days the dressings may be removed and the use of Scarpa's shoe resumed, * * treatment being carried on very slowly."

In contra-distinction to this plan of rectifying the deformity by supplementing tenotomy by gradual mechanical extension requiring, as our author says, "from two to three months" to correct the plantar deformity, and a subsequent period of approximately the same length to restore the natural relations at the ankle joint, I believe that after tenotomy the parts should be brought into the normal position at once, and retained in this position for ten days or two weeks, to allow the material connecting the ends of the divided tendons to become organized. I believe that there is no danger of non-union from following this course, and I am sure that by so doing we save the patient a vast deal of suffering and a very considerable amount of time.

In cases of old ankylosis at the knee, however, in which *brisement forcé* is requisite to reduce the leg to a straight position, the violence of the manipulations may extend the external puncture to a gaping wound, and it is therefore advisable to allow forty-eight hours to elapse between the tenotomy and the breaking up of the ankylosis. Even should the puncture enlarge, however, I believe with proper care in washing and draining there would be no more trouble than after a properly performed osteotomy.

When Delpéch divided the tendo Achillis he had an idea that the elongation of the contracted tissues was procured by the stretching of the medium which connected the ends of the divided tendon, and he lays down the following rules to be observed in the performance of tenotomy.*

"2nd. Immediately after division of the tendon, the divided extremities of the tendon should be brought into contact and so held by a suitable apparatus until reunion is accomplished.

"3rd. As reunion can only take place by an intermediate fibrous substance (*organisation inodulaire*), gradual and careful exten-

* De l'Orthomorphie, tome ii., p. 330.

sion should be made, to give the required length to the shortened muscles, before solidification takes place.

"4th. Extension being complete, the limb should be fixed in this position, and be so retained until the new substance has acquired that firmness of which it is susceptible."

Stromeyer agreed with Delpech in condemning the practice of immediate extension after tenotomy, though he remarks* that the latter's rule "is based upon the false assumption that the elongation of the shortened muscle is produced through the substance of the cicatrix. The amount of this substance of the cicatrix is too insignificant for that purpose." Stromeyer believed that the operation of tenotomy had the effect of impairing the contractibility of the muscle, and that in this way the relief afforded by tenotomy was to be explained, as he thought the bond of union between the ends of the divided tendon was but a few lines in length.

Dr. W. J. Little followed the teachings of Stromeyer, by whom his own club-foot was cured, and says,† "as an absolute rule no replacement of the parts should be attempted until after the puncture has cicatrized, and as a general rule no sudden or rapid replacement is proper until some days later. Much has been written respecting the propriety of immediate replacement. It is unnecessary in slight cases, and impossible in severe ones." He also remarks,‡ that after tenotomy "the limb should be laid into its deformed position on its outer side, and supported by a common or pasteboard splint. * * * After the healing of the wound great care is necessary on the part of the surgeon in the manner of conducting the extension of the medium which connects the ends of the divided tendon. * * * In many cases the slightest pressure exercised by the instrument will suffice to overcome the deformity without producing pain, provided attention be daily paid, and the straps and screws be tightened whenever they become loosened by the progress which the foot makes in the required direction. In other subjects where the resistance is greater, and more pressure is required, it is accompanied by a greater degree of pain, but the surgeon must constantly bear in mind, that after the

* *Beitrag zur Operativen Orthopadik*, Hanover, 1838.

† *On the Nature and Treatment of Deformities of the Human Frame*, London, 1853, p. 305.

‡ *A Treatise on the Nature of Club Foot and Analogous Distortions*, p. 32, et. seq.

performance of an operation or in treating a case without an operation, he must not always expect to restore the foot rapidly to its natural position, he must guard against violence and endeavor by the most assiduous and patient attention to the case to overcome the difficulties presented. * * * Occasionally the pain in the sole of the foot produced by the pressure required to bend the ankle joint is intolerable," and he also remarks that he found it so in his case.

Now, Paget* found that the half of the tendon of a rabbit, whose tendo Achillis had been divided sub-cutaneously six days before, would sustain a weight of ten pounds, or twenty pounds for the whole thickness of the tendon, and "that the bond of connection which had been ten days forming in a small young rabbit, after bearing suspended weights of twenty, thirty, forty and fifty pounds, was torn at fifty-six pounds. * * * With its tenacity it had acquired much of the inextensibility of the natural tendon." The rabbit from which this tendon was removed weighed "scarcely more than a pound," and when we consider the amount of tension on this tendon "not more than two lines in its chief diameter" endured with very little elongation according to Paget, it is easy to understand that Dr. Little by no means exaggerates the pain caused by endeavoring to elongate to the extent of an inch or more a tendon many times the size of the one here mentioned, and consequently capable of many times the resistance.

Little was also altogether wrong in stating that immediate replacement "is unnecessary in slight cases, and impossible in severe ones," for no measure is unnecessary which saves time, pain, and inconvenience, and if it is found impossible to alter the position of the foot immediately after tenotomy, owing to other mechanical causes than the resistance of the tendon, it is due to the fact that you have not made the operation sufficiently thorough, and that the case demands severer treatment, for no foot whose position can not be improved immediately after tenotomy, when freed from the restraint of the severed tendons, becomes more pliant from the subsequent reunion of the separated ends.

Mr. Broadhurst uses Scarpa's shoe for the correction of the deformity, and says: † "It may be applied as soon as the puncture

* Lectures on Surgical Pathology, London, 1870, p. 202.

† The Deformities of the Human Body, London, 1871, p. 68.

has healed, on the fourth day namely; and extension may be carried on slowly and gradually until it is complete in about six weeks."

As the tendon is sufficiently firm to give voluntary motion in two weeks, the amount of extension obtained during the subsequent four weeks is obtained at the expense of the size of the connecting band and with much discomfort on the part of the patient.

He also says:* "That the new material may be extended to any required length. When, however, the divided ends of the tendon are widely separated and kept apart, *reunion will not take place.*"

In his statement he is mistaken; at any rate, as far as concerns the amount of separation possible in the human subject.

Billroth says:† "We should not await complete cicatricial contraction of the divided tendon, but must stretch the young cicatrix; the orthopedic treatment may begin ten or twelve days after division of the tendon in club-foot, either by extension, manipulation and apparatus, or by straightening the foot and applying a plaster dressing."

Erichsen avoids the subject, and leaves the reader in doubt whether he is in favor of immediate reposition or not, while Bryant approves the theory but condemns the practice, as he says, quoting from Mr. Adams,‡ "There is no reason for believing that in the treatment of deformities by tenotomy direct approximation and reunion of the divided extremities of the tendon must be obtained, and that the required elongation is afterward to be procured by gradual mechanical extension of the new connecting medium as a piece of India rubber;" and then follows this three pages further on by remarking: "The splint should invariably be applied and fixed to the foot in its deformed position, and the stretching process commenced on the third or fourth day, and be completed at the latest by the second week."

Scouttlen seems not to have been precisely clear in his own mind as to the best method to pursue, for though he says§ "My

* Op. Cit., p. 48.

† General Surgical Pathology and Therapeutics, translated from the Fourth German Edition by Charles E. Hackley, A.M., M.D., New York, 1871, p. 578.

‡ Practice of Surgery. H. C. Lea & Co., Philadelphia, 1879, p. 732.

§ Memoir on the Radical Cure of Club-Foot, p. 42.

own practice is to leave the patient at liberty for four or five days; the object is to avoid extension, which, if combined with the irritation caused by the division of the tendon, might induce inflammation; yet later on he appears to favor the opposite view, and says: "It is generally admitted as necessary that the two ends of the tendon should be as nearly approximated as possible, and then to cause a progressive lengthening. The newly-secreted substance appears to be viewed in the light of glass rendered soft by the application of heat, which may be extended at pleasure.

"We instantly reply to such an assertion that if the elongation takes place as is supposed, it can only be by diminishing the thickness and cohesive power of the newly-formed tissue, and that this tissue would be thus exposed to the possibility of being broken by violent or too long continued extension. It should still further be recollected that nature is not too bountiful or extravagant in the use of her *vis medicatrix*, and thus when she has caused the reunion of divided parts the secretion of the fluids destined to become solidified ceases. Notice the phenomena which occur in the case of a fractured bone. If the fragments are closely approximated the plastic juices are secreted in small quantity, whereas if they are widely separated the secretion is very abundant, and the callus extends to some distance around the parts.

"These facts would lead us to infer that it is wrong to attempt bringing together the divided ends of the tendon, and that it would be better within certain limits to pursue an opposite course."

What the "certain limits" were, however, he does not seem clearly to have known, and so contents himself with taking the middle course, bandaging the foot and allowing it to stay in whatever shape it chose for the first few days after the operation.

Mr. Barwell becomes unnecessarily excited at the idea of tenotomy, failing to recognize the fact that there are tendons which do require division as well as others which do not, and remarks,* in regard to cutting a contracted tendon, "indeed, its severed ends would fly asunder like a taut cable parting in a gale, and there would never be any chance of their coming together again any more." As the object of cutting a shortened tendon is to obtain a splice between the ends which shall increase its length by an

* On the Cure of Club-Foot Without Cutting Tendons. London, 1865, p. 20.

amount equal to the distance between the ends, it is desirable that they should not "come together again any more," or else the operation would have been productive of little if any good. He further remarks,* "Nevertheless, we are not to imagine that the operation is necessarily productive of good results, or that it may not be followed by certain ill effects. It must be remembered that the muscular contraction has only taken place in consequence of deficient resistance. By dividing the tendon we completely cut off all connection between the muscle and the foot, annihilating all resistance to contraction, and as a consequence the calf retracts in the leg, shortening itself to the extent of an inch or more. In the course of two or three days a new material, of commensurate length, reunites the two ends of the tendon, the connection between foot and muscle being thus re-established. But the latter, having retracted at the operation, is of course shorter than ever, and to its force is now added the constringent power of the new material between the ends of the tendon. The situation of this fresh matter enables it to exert its contractile force both on the muscle above and on the foot below; naturally, therefore, the weaker part must yield. Since, however, the muscle is of itself strong enough to distort the foot, the added power of the scar must increase the distortion unless counteracted. But the foot is prevented from yielding by machinery; it is even screwed toward a natural position, and the scar material may be stretched to a certain amount while it remains soft. But it very soon becomes too hard to be stretched, and even in hardening contracts again to at least the same amount as it had previously yielded—the scar, after a period, being of the same length, or indeed a little shorter than the interval between the tendonous end produced at the moment of division by contraction of the muscle. Or, to put it in other words, the gap formed at the instant of operation is produced by contraction of the calf muscle and not by improved posture of the foot, since no change of posture takes place at the time. As soon as the new material filling this gap becomes too hard to be stretched by practicable instruments it contracts again, and the force of this contraction, as well as the power of the machine on the foot, is exerted on the muscle. Therefore, as this scar decreases rather than increases in size, it follows that the muscle, not the tendon, is

*Op. Cit., p. 5.

the part stretched; and this result might just as well have been effected without any use of the knife.

"Hence, the tenotomy has simply had the following results: it has allowed the calf to shorten and therefore produced of itself a certain deformation and debility; it has not superseded by a single day the use of mechanical force, since, after all, the muscle is the part that must yield. The operation renders the first application of machine power apparently more effective, since there is nothing to resist its action; but the work to be done is only postponed till solid union has taken place, and thus the division of the tendon has simply wasted all that time which was employed in the repairs of the artificial injury."

These statements are so absurd, and so at variance with well known facts as not to demand a reply, and had they not been made by Mr. Barwell I should not have thought them worthy of mention.

Mr. Wm. Adams thinks that the sheath of the tendon is of primary importance in securing union of the ends of the divided tendon, while Sir James Paget is of the opposite opinion. Adams says: * "It appears that complete transverse division by open wound does not destroy the influence of the sheath, as has been supposed, because it does not retract as the divided ends of the tendon do. * * * The retraction of the sheath appears to be prevented mainly by the processes of fascia which extend between and from the sheaths of the deeper tendons; and in part also by its slender cutaneous connections. * * * Moreover, the continuity of the divided sheath appeared in these experiments to be quickly re-established by adhesion taking place between its cut edges and the margins of the cutaneous wound." Mr. Adams also says,† speaking of sub-cutaneous tenotomy: "On the second day, where neither extravasated blood nor inflammation follows the operation, the sheath forms an empty tubular connection between the divided ends of the tendon, and is slightly thickened by the infiltration of blastematous material among its fibrous elements. On the fourth day the tubular character of the sheath is nearly obliterated by the increased thickening and succulency

* A Series of Experiments Illustrating the Reparative Process in the Tendons of Rabbits after Division by Sub-cutaneous and Open Wounds, London, 1860, p. 113.

† Op. Cit., p. 112.

of its walls. The vessels of the sheath are injected ; but there is not necessarily any evidence of inflammation. The sheath is infiltrated a little beyond the cut extremities of the tendon which it therefore incloses and externally thickens. On the sixth day, a solid bond of union connects the divided extremities of the tendon, with which, however, it has but a very slender connection. The extremities of the old tendon can be easily separated, or as it were enucleated. * * * On the eighth day, the adhesion between the old tendon and the new connective tissue was too close to admit of easy separation. On the tenth day, the process of enlargement by the separation of the fasciculi of the old tendon and the insertion of the new reparative material between them was seen to commence in the lower extremity. * * * On the fifty-fourth day, the exact line of separation between the old and new tendon was very indistinct above, but still traceable below."

Having thus proved to his own satisfaction that the connecting bond is formed from material not thrown out from the ends of the divided tendon, but from the sheath connecting the two, which at first forms an empty tubular connection between the divided ends of the tendon but soon becomes a "solid bond of union" "by the increased thickening and succulency of its walls," I do not understand why he should object to the immediate restoration of parts to their normal position, but recommend the gradual reduction of the deformity during the process of consolidation of this "bond of union."

If the ends of the tendon play so inconsiderable a part in the process of repair there is no object in retaining them in close apposition, and the sheath will not pour out a larger amount of reparative material by having its secreting surface brought into action by degrees, instead of all at once, while later on, when organization is taking place in the reparative material, I believe that the process will go on to greater advantage if the ends of the tendon are retained in a state of quiet than if they are moved further apart day by day. Mr. Adams, however, is of a different opinion, and remarks : * "It seems rational to conclude from the account of reparative processes given above that the rate of exten-

* Club-Foot : Its Causes, Pathology and Treatment, by Wm. Adams, F. R. C. S. Philadelphia, 1872, p. 44.

sion should be regulated by the activity of the reparative process in the divided tendon, but practically it is often limited by the ligamentous rigidity of the articulations.

"In well-nourished infants the full length required in the divided tendo Achillis should, I believe, be obtained in a fortnight, if practicable. In the adult, when the limb is well nourished, it should be obtained in from three to four weeks, but in atrophied paralytic limbs it should not be obtained in less than from five to six weeks.

"The object of gradual extension is not so much to elongate or stretch the new material uniting the divided extremities of the tendon as generally supposed; but rather to regulate the length of new material, or as it may be called the new tendon, while we have the opportunity of so doing, *i. e.*, during the period of its formation or regeneration, and the rate at which this is accomplished must have reference to the activity of the reparative process, and the length of new tendon required.

"This important part of the treatment must, therefore, be left to the judgment of the surgeon, and in cases of paralytic equinus, where the ligaments do not hold the joint after division of the tendon, and the foot can at once be brought into its natural position, or even carried beyond, great caution is required to prevent talipes calcaneus, which is always liable to occur when the extension is conducted too rapidly in cases in which there is but little resistance from the adapted shortening of ligaments; but if this ligamentous resistance exists, as in some cases of long standing in the adult and in severe cases of congenital varus, it will not be possible to proceed at the desired rate, and it may even become necessary to divide the tendon a second time before the required length can be obtained."

Here, again, is, I think, an argument against the gradual reduction of the deformity; the fact that the pain caused by stretching the contracted ligaments is too severe to permit the requisite speed necessary to correct the deformity before the "bond of union" has become too firm to be stretched any more, and so a second tenotomy is required, of which he, himself, says:* "If much separation be required, a second operation is generally unsatisfactory in its results, and beyond a second operation very little advantage can ever be obtained from operative treatment," because

* Reporative Process of Human Tendons, London, 1860, p. 80.

"adhesions will, in many cases, prevent sufficient separation of the divided extremities of the tendon being obtained."

Paget did not look on the tendons in his rabbits with precisely the same eyes as Mr. Adams, though many of their conclusions are similar. He especially differs in attributing little or no importance to the connective tissue sheath, for reasons which Mr. Adams believes to be fallacious, as I have shown. According to Paget,* "in rabbits forty-eight hours usually elapse before there are distinct signs of the production of the proper reparative material in the fibro-cellular tissue that lies between and close round the separated ends of the tendon, as well as in the tendonous fasciculi of those ends. * * * To the naked eye it appears, after three days, as a soft, moist, and grayish substance with a slight reddish tinge extending from one end of the tendon to the other, having no well marked boundary and merging gradually into the surrounding parts. In its gradual progress the reparative material becomes commensurately firmer, tougher and grayer, the ruddiness successively disappearing from the circumference to the axis; it becomes also more defined from the surrounding parts, and after four or five days forms a distinct cord-like vascular bond of connection between the ends of the tendon, *extending through all the space from which they have retracted*, and for a short distance ensheathing them both. * * * In every experiment one finds cause for admiration at the manner in which a single well-designed and cord-like bond of union is thus gradually formed where at first there had been a uniform and seemingly purposeless infiltration of *the whole space left by the retraction of the tendon*." (The italics are mine.)

I have shown that Adams' experiments lead to the logical conclusion that there is no danger in immediate separation of the ends of the divided tendon. Practically, in the human subject, it would be almost impossible in many instances to keep them closely approximated, and if we do not agree with Mr. Adams in accepting the importance of the sheath in the production of the new bond of union, but prefer the theory of Sir James Paget, there is still no more reason for advocating the retention of parts in the distorted position for a longer or shorter period before commencing replacement, and the statement made in this same connection,

* Lectures on Surgical Pathology, London, 1870, p. 200.

and which I have quoted before, that the tendons of a one-pound rabbit, ten days after tenotomy, sustained a weight of even fifty pounds before breaking, and with but slight increase in length, is an additional argument in favor of immediate replacement as a means for securing increased length of tendon in the shortest and least painful manner.

In this country few have been in favor of immediate replacement. Bauer adopted a midway course. After tenotomy he says: * "The extremity is then reduced to its original malposition. * * This plan has the advantage of insuring a perfect closure of the wound, precluding the impending danger of air entering when the parts are subsequently handled. Nor is this apparent delay a real loss of time, inasmuch as the reparative process does not usually commence before the fifth day. If, at the end of that time, the wound be found properly closed, I place the patient once more under the influence of chloroform, and by main force reduce the malformation as far as it can safely be done. In breaking up some adhesions or in tearing some ligaments, one risks nothing since the anæsthesia seems to protect against reactive consequences."

I think this plan should only be followed where the tenotomy is of the hamstrings, and is but a preparatory measure to *brisement forcé* required on account of firm ankylosis.

Gibney says: † in Talipes Equinus from Infantile Paralysis, "yet I would not advise tenotomy unless he were prepared with some form of apparatus that would prevent too much traction. The severed ends must be closely watched to prevent elongation, and thus an irremediable calcaneus."

Hutchinson says: ‡ "After three or four days you should begin the mechanical treatment."

There are, however, some American surgeons who think it good practice to place the parts at once in the normal position. Gross says: § "As soon as all the faulty structures have been divided, the foot is forcibly flexed and extended in order to break up any morbid adhesions that may exist, and separate as widely as possible the

* Lectures on Orthopedic Surgery, New York, 1868, p. 69.

† Notes on the Management of Orthopedic Cases, Louisville, 1880.

‡ Lectures on Club Foot delivered at the College of Physicians and Surgeons, 1880, p. 114.

§ A System of Surgery, Philadelphia, 1882, vol. ii., p. 1039.

ends of the tendons, as much force being used for this purpose as may be compatible with the safety of the limb. The advantage gained in this way is generally very great, and it is remarkable how tolerant the parts are of manipulation. The little puncture made in the operation is covered with a strip of adhesive plaster, and usually closes in a very short time. The limb, bandaged from the toes up, is immediately placed in an appropriate apparatus, either with or without a stocking. In the former case, it may be well to cut off the part of the stocking corresponding to the toes in order that if undue swelling arise the fact may at once become apparent. This plan has been constantly pursued by me for many years, and I never have had cause to regret it; on the contrary, I believe it to be decidedly preferable to waiting three or four days, as usually recommended; for at the end of that time the parts are often so tender as to be intolerant of extension and manipulation. It is only in cases of an extraordinary character that this rule should be deviated from. There need be no apprehension of a want of reunion of the ends of the divided tendon when this course is adopted. I have myself never met with such an occurrence, nor heard of one that was entitled to credence."

Hamilton says:* "There need be no hesitation in forcibly restoring the foot to position at once, and in thus separating widely the ends of the divided tendons, nor, I may add, need there be any delay when the dressing is completed in applying the proper mechanical apparatus, and thus holding the ends of the tendon well apart. Union occurs as speedily when this method is pursued as when other and more dilatory measures are adopted."

Sayre says:† "After division of any of the tendons or fascia for the relief of the different distortions of the foot, and closing the wound in the manner which has been described above, bring the foot immediately into its natural position, or as nearly so as can be done, and retain it there."

In 1839, Dr. Mutter, speaking of this subject and also of the practice of placing the ends of the severed tendons in as close approximation as possible, says:‡ "Although this practice has the

* The Principles and Practice of Surgery, New York, 1873.

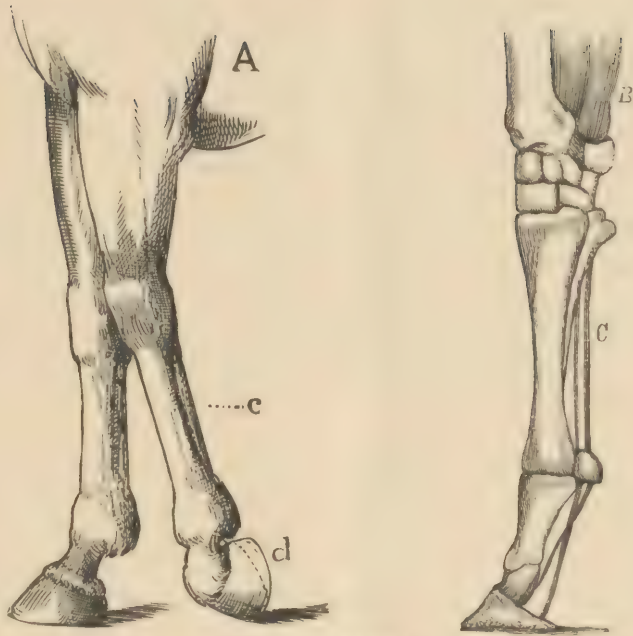
† A Practical Manual of the Treatment of Club Foot, by Lewis A. Sayre, M.D., Fourth Edition, New York, 1882, p. 38.

‡ A Lecture on Loxarthrosis, or Club Foot, By Thomas D. Mutter, M.D., Philadelphia, 1839, p. 66.

sanction of high authority, and although it has repeatedly effected cures in my own hands, I am, nevertheless, from *experience*, induced to give the preference to the method introduced chiefly by Pauli, of Landau, and Bouvier, of Paris. Instead of attempting to reunite the tendons, they bring the foot down at once as nearly as possible to its proper position. * * The objection urged against this plan of treatment, viz.: that there is danger, especially in old cases, of no ultimate reunion of the tendon, is utterly untenable, because ample experience has proven that this union *invariably* occurs, even when the extremities of the tendon are separated two or three inches. In my own practice I have repeatedly seen this take place. The great advantage which it possesses is in the saving of time; although there is less pain when the heel is depressed as far as possible *immediately* after the operation than when this is postponed for two or three days. I am fully convinced that I might have cured several of my patients in *one-half* of the time employed had I pursued the former instead of the latter method."

The principle of immediate correction of the deformity has been applied with marked success to the treatment of deformity in the horse, as the following letter from Mr. J. Roalfe Cox, M. R. C. V. S., which forms the appendix to Mr. Adams' Jacksonian prize essay on Club Foot will testify:

"In 1861, the bay colt called 'Suspicion,' by Alarm, out of Blue Bell, had congenital deformity of one fore foot, due to insufficient length of the flexor perforans tendon. * * * The colt being at the time of my examination *six months* old, I found that he could only tread on the front of the hoof, the entire sole of the foot presenting backward and unable to touch the ground. The result at this period being that the front of the hoof was worn by contact with the ground, whilst there was preternatural depth of the hoof at the back part from continuing growth and absence of attrition (see cut). * * * The colt being valueless for training, or indeed service of any kind, tenotomy under my advice was determined on as the only possible recourse, and accordingly within a few days I performed the operation, under chloroform, by introducing a narrow blade between the two tendons, and dividing the inner one. The immediate result was a perfectly adjusted position of the limb, and a separation to the extent of two inches between the cut ends of the tendon.



(FROM ADAMS.)

A. Sketch, by Mr. J. R. Cox, of the race-horse "Suspicion," who was foaled with one foot contracted in the position represented. The hoof, from not having been used, grew into the form shown in the drawing, with a considerable thickness posteriorly, d, c, the point at which the flexor perforans tendon was divided. B. Anatomical sketch showing relations of the superficial and deep flexor tendons; C indicates the point at which the flexor perforans was divided.

"Before the colt was allowed to rise (having been placed on his side for operation), the excess of growth at the back part of the hoof was pared down to natural shape, and a bandage over a light compress placed around the leg.

"On the colt resuming the standing position, the obliquity of the pastern from his own weight and pressure was rather in excess of that of the sound limb, from the divided tendon still further separating, and which I considered a desirable indication. Eventually within a few weeks, the position became symmetrical with that of the other limb.

"'Suspicion' subsequently underwent the usual course of hard work in training.

"In 1863, when two years old, he ran in three races; in 1864 he

ran in six races, winning two ; in 1865 he ran in nine races, winning two of them, the latter events being the "Goodwood Stakes," two miles and a half, beating ten horses, and the "Huntingdonshire Stakes," two miles, beating six horses. During this time, as I have since been informed by the gentleman who then owned him, this leg had never failed, nor shown indication of weakness."

I think I could hardly bring forward a more forcible example in favor of immediate replacement than this of tenotomy in the horse, the absence of trouble during the after-treatment, and the magnificent results obtained speaking for themselves, and it seems curious to me that Mr. Adams should publish this case in the very book in which he condemns the practice of immediate replacement.

The conclusions that I have reached in regard to this subject are as follows :

I. That after tenotomy the parts should be immediately restored as nearly as possible to the normal position, and there retained during ten days or two weeks, after which time whatever subsequent treatment may be necessary to vitalize paralyzed muscles, or complete the restoration of natural functions should be carried out as may be necessary.

II. That this proceeding is accompanied by the least discomfort to the patient, and annoyance to the surgeon, and causes a vast saving of time.

III. That there is no more danger of non-union of the ends of the divided tendon in this manner than by other modes of proceeding.

IV. There is less apt to be a thin, imperfect bond of union between the ends of the tendon than when gradual reduction of the deformity is practiced.

V. That this mode of operation is applicable at the foot, knee, thigh, or neck, where there is no ankylosis to be overcome, but that in cases of long standing ankylosis at the knee when tenotomy is but preparatory to *brisement forcé*, the latter should be deferred for forty-eight hours, to avoid possible risk from gaping of the external wound due to the violence of the manipulations.

Should the deformity at the knee be due simply to contracted muscles, immediate replacement may be practiced here also.

